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April 10, 1992

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DELIVERY BY HAND

Ms. Donna R. Searcy
Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

Federal Communications Commission
Office of the Secretary

Re: ET Docket No. 92-28; File No. PP-32

Dear Ms. Searcy:

Enclosed for filing on behalf of Motorola Satellite Communications, Inc. ("Motorola") are the originals plus five (5) copies of Motorola's Supplement to Request for Pioneer's Preference in the above-referenced proceedings. Also enclosed in a separately bound volume are the requisite number of copies of the Attachments to this Supplement.

By separate cover letter, Motorola has also requested that confidential treatment be accorded to a bound set of materials which is entitled Confidential Appendix. Only the original of this Confidential Appendix in a sealed envelope is being supplied with this filing. A courtesy copy of the Confidential Appendix will be delivered to the Office of Engineering and Technology.

Please call me at the above-noted telephone number if you have any questions concerning this filing.

Respectfully submitted,



Philip L. Malet

Counsel for Motorola Satellite
Communications, Inc.

Enclosures

cc: Dr. Thomas P. Stanley

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

ORIGINAL
FILE

In the Matter of:

MOTOROLA SATELLITE
COMMUNICATIONS, INC.

Request for Pioneer's Preference
to Establish a Low-Earth Orbit
Satellite System in the 1610-
1626.5 MHz Band.

ET Docket No. 92-28

PP-32

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To: Office of Engineering and Technology

Federal Communications Commission
Office of the Secretary

SUPPLEMENT TO REQUEST FOR PIONEER'S PREFERENCE

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April 10, 1992

SUMMARY

Motorola Satellite Communications, Inc. ("Motorola") submits this supplement in further support of its request for a pioneer's preference for its IRIDIUM™ system. Included with this supplement is additional information and materials concerning the Motorola's pioneering efforts in designing its IRIDIUM™ system as well as a description of many of the innovative features of its design. There can be no serious doubt, based upon this information and the underlying IRIDIUM™ system application, that Motorola is entitled to a pioneer's preference in this proceeding. The IRIDIUM™ system will be the first cellular-like satellite system to provide direct voice grade communications to personal handheld units throughout the world. It also is the only system that will project interlinked cellular beams to every point on the globe on a continuous basis.

Motorola has also supplied information and materials further demonstrating the technical feasibility of the IRIDIUM™ system, including preliminary results of various experiments it has undertaken over the past few years. In any event, Motorola's system application provides ample assurances that the IRIDIUM™ system is technologically feasible.

Finally, Motorola is not asking the Commission to grant it a nationwide monopoly. Motorola only is requesting authority to operate in 10.5 MHz of the RDSS bands. Other systems could be accommodated in the remaining two-thirds of the RDSS spectrum.

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FEDERAL COMMUNICATIONS COMMISSION
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To: Office of Engineering and Technology

SUPPLEMENT TO REQUEST FOR PIONEER'S PREFERENCE

Pursuant to Section 1.402(c) of the Rules and Public Notice, Mimeo No. 22205 (Mar. 11, 1992), Motorola Satellite Communications, Inc. ("Motorola") hereby supplements its request for a pioneer's preference in the above-captioned proceeding.^{1/} This supplement is occasioned by the Commission's recent revisions to its pioneer's preference rules,^{2/} the first

^{1/} By Public Notice, Mimeo No. 22153 (Mar. 9, 1992), the Chief Engineer accepted for comment and consolidated the requests for pioneer's preference filed by Motorola, Constellation Communications, Inc. ("Constellation"), TRW, Inc. ("TRW"), Loral Qualcomm Satellite Services, Inc. ("LQSS"), and Ellipsat Corporation ("Ellipsat"). Motorola timely filed its consolidated comments to these requests on April 8, 1992. The Chief Engineer also issued a Public Notice, Mimeo No. 22205 (Mar. 11, 1992), announcing April 10, 1992, as the deadline for filing pioneer's preference requests for low-Earth orbit satellite systems above 1 GHz.

^{2/} See Memorandum Opinion and Order in GEN Docket No. 90-217, 57 Fed. Reg. 7879 (Mar. 5, 1992).

interpretation of those rules in the "small" LEO proceeding,^{3/} and updated information concerning the technical feasibility of the innovations encompassed in the IRIDIUM™ system.^{4/} Motorola urges the Commission to grant promptly its request, as supplemented herein, for a nationwide and global pioneer's preference to be associated with its pending application to construct, launch and operate the IRIDIUM™ system.

I. OVERVIEW

On December 3, 1990, Motorola filed its application to construct, launch and operate the IRIDIUM™ system.^{5/} In this comprehensive filing, Motorola provided the Commission with a thorough technical description of all five segments of the proposed system -- the space segment, gateway segment, system control segment, subscriber unit segment and launch segment. The

^{3/} See Tentative Decision in ET Docket No. 91-280, FCC 92-21 (Feb. 11, 1992).

^{4/} Sixteen months ago Motorola submitted a request for a pioneer's preference in conjunction with its application to construct, launch and operate the IRIDIUM™ system. See Application of Motorola Satellite Communications, Inc. for IRIDIUM™ -- A Low Earth Orbit Mobile Satellite System, File Nos. 9-DSS-P-91(87) & CSS-91-010, at 7-8 (Dec. 3, 1990). That request was subsequently renewed by a separate filing in light of the adoption of the Commission's pioneer's preference rules. See Request for Pioneer's Preference, Motorola Satellite Communications Inc. (July 30, 1991). In that filing, Motorola incorporated by reference those portions of its pending application which bore upon its pioneer's preference request. Id. at 1 n.2.

^{5/} Motorola subsequently submitted additional information to the Commission in a supplement to its applications. See Supplemental Information to IRIDIUM™ System Application, File Nos. 9-DSS-P-91(87) & CSS-91-010 (Feb. 22, 1991).

IRIDIUM™ system will be the first satellite-based cellular-like system to provide direct communications to personal handheld units. It is the only system that will completely cover the globe with interlinked cells. Motorola identified many of the innovative technologies which will be included within the IRIDIUM™ system, including its cell management and antenna configurations, bidirectional frequency plan, on-board microprocessing capabilities, intersatellite links, power management schemes, telemetry, and tracking and control capabilities. All of these innovations were described with sufficient particularity from which the Commission could determine their technological feasibility.^{6/} The viability of the IRIDIUM™ system was also demonstrated in the detailed link budget calculations and sharing analyses accompanying the filing.

Motorola further described in its application, the new and innovative communications services that the IRIDIUM™ system would offer to persons located within the United States and throughout the world. The IRIDIUM™ system was the first

^{6/} Motorola's aggressive plans for implementing the IRIDIUM™ system also were detailed in its application. Utilizing assembly-line manufacturing techniques, Motorola anticipates constructing and launching all seventy-seven of its satellites by the beginning of 1997. The application also describes, in detail, the services to be provided over the IRIDIUM™ system, the frequencies Motorola proposes to use for its user, feeder and intersatellite links, the areas of service coverage, and the conflicting RDSS licensing rules along with supporting waiver requests, all in accordance with Section 1.402(a) of the Rules. On October 16, 1991, Motorola filed a petition for rulemaking, suggesting that the Commission change its RDSS and domestic allocation rules in order to accommodate the IRIDIUM™ system. See Petition for Rulemaking, ET Docket No. 92-28 (Oct. 16, 1991). Motorola continues to believe, however, that the Commission can avoid a rulemaking proceeding and grant it an authorization to construct the IRIDIUM™ system pursuant to appropriate waivers.

communications system proposed which would be able to provide a personal global voice communications capability to handheld portable mobile units on a real time basis. Utilizing its constellation of seventy-seven interconnected satellites in seven low-Earth orbit ("LEO") polar planes, the IRIDIUM™ system can provide universal service to all points in the world twenty-four hours a day, seven days a week. None of the other satellite systems proposed to date can make such a claim.

In addition, Motorola presented substantial evidence demonstrating the spectrum efficiency and high capacity of the IRIDIUM™ system. The tremendous frequency reuse associated with its unique combination of spot beams, bidirectional operations, FDMA/TDMA modulation, and cellular management systems will allow for up to 4,400 simultaneous voice channels over CONUS in just 10.5 MHz of the RDSS uplink band. This capacity translates into an unprecedented 419 channels per megahertz of service band spectrum. Moreover, as a result of this efficient system design, over two-thirds of the RDSS bands would remain available for licensing of other LEO systems.

II. HISTORY OF THE IRIDIUM™ SYSTEM CONCEPT

Motorola's application only describes a small portion of the development of the IRIDIUM™ system. Motorola Inc., the recipient of the first Malcolm Baldrige National Quality Award for excellence, has been involved in satellite-based communications for over 25 years, mostly working for the U.S.

Government.^{7/} Motorola began developing the IRIDIUM™ system concept in 1987. By the summer of 1988, Motorola had developed a conceptual design of the IRIDIUM™ system and began briefing potential satellite manufacturers and launch vehicle suppliers. Approximately one year later, Motorola began a program of private presentations to potential customers and investors, including Telesat, Inc./TMI, AMSC and INMARSAT.^{8/} Several Commissioners were also privately briefed in March 1990 on Motorola's LEO satellite efforts.

On June 26, 1990, Motorola described the IRIDIUM™ system in public announcements issued simultaneously in four countries.^{9/} That same day, representatives from Motorola gave a technical presentation to the Commission staff in Washington, D.C. on the IRIDIUM™ system. A significant number of press reports soon followed concerning Motorola's efforts to develop a new concept in personal mobile voice communications.^{10/} Approximately one month later, Motorola released its first

^{7/} When Neal Armstrong spoke from the moon, he was using Motorola electronics. Motorola built the baseband processors and modems for NASA's advanced communications technology satellite system.

^{8/} All of these private briefings were conducted pursuant to confidentiality agreements. At the Commission's request, Motorola is prepared to make available in confidence a complete list of those companies briefed on the IRIDIUM™ system prior to the filing of its application.

^{9/} On June 26-27, 1990, Motorola formally announced the IRIDIUM™ system concept in New York, London, Beijing and Melbourne. The Commission staff was also briefed at that time on the parameters of the system.

^{10/} See Attachment A hereto which contains an accumulation of news accounts between June 26, 1991 and July 2, 1991.

technical paper to the public at a mobile satellite communications conference in Adelaide, Australia.^{11/} Since that time, Motorola has given numerous public and private briefings concerning the IRIDIUM™ system, including one in October 1990, at the request of the Commission, at an open technical forum on new satellite communications.

Motorola also extensively participated in the Commission proceedings to determine the United States spectrum positions for the World Administrative Radio Conference in Spain ("WARC-92"). For example, Motorola was the only party that requested changes in the international allocation tables to accommodate bidirectional operations in the RDSS uplink band. It also actively promoted throughout the world the U.S. positions on LEO/MSS spectrum above 1 GHz, and as the Commission is well aware, Motorola vigorously supported the United States delegation at WARC-92.

III. TECHNOLOGICAL INNOVATIONS ASSOCIATED WITH THE IRIDIUM™ SYSTEM CONCEPT

There are numerous technological and service innovations associated with the IRIDIUM™ system design, including the following features:

- (1) The ability to provide personal mobile communications to anyone, anywhere, anytime using earth terminals that are small, lightweight,

^{11/} See "Low-Earth Orbit Global Cellular Communications Network," Dr. Raymond J. Leopold (Aug. 23, 1990) (Attachment B hereto).

pocket-sized, battery-operated, and have low-profile antennas;

- (2) The coverage of the Earth with cells, coupled with beam hopping/TDMA, provides for a high degree of frequency reuse;
- (3) Distributed processing systems in orbit using intersatellite links. Each IRIDIUM™ satellite demodulates the signals, converts them to baseband, employs on-board processing, and routes efficiently;
- (4) Soft, trouble-free cell and satellite-to-satellite handoffs, and the method for predicting such handoffs;
- (5) Bidirectional operation in the service bands;
- (6) Multiple hopped beam deployable satellite antenna systems;
- (7) A power management system whereby overlapping cells are turned off as satellites approach the polar regions; and
- (8) Devices for narrow band Doppler compensation which conserve power and can be used with handheld communications units.

These innovations are substantial enhancements over the current state-of-the-art in mobile satellite communications. Indeed, Motorola has already received, or is about to receive, U.S. and international patents for many of the underlying technologies associated with the IRIDIUM™ system. For example, on May 21, 1991, Motorola was issued a U.S. patent for the multiple beam deployable space antenna system to be used on IRIDIUM™ spacecraft.^{12/} This antenna system will project the multiple spot beams on the Earth into uniformly sized cells in order to provide for spatial diversity and frequency reuse.

^{12/} See U.S. Patent No. 5,017,925 (filed Oct. 10, 1990; issued May 21, 1991). (Attachment C hereto).

Another patent recently was obtained for a calibration method and device for narrowband Doppler compensation which will preserve power within the IRIDIUM™ handheld units.^{13/} Many other relevant patent applications are still pending.^{14/}

IV. IRIDIUM™ SYSTEM INNOVATIONS WILL LEAD TO THE
ESTABLISHMENT OF SERVICES NOT CURRENTLY PROVIDED
AND TO SUBSTANTIAL ENHANCEMENT OF EXISTING SERVICES

The innovations noted above unquestionably will lead to the establishment of mobile communications services not currently being offered, as well as the substantial enhancement of existing mobile communications services. To date, commercial land mobile satellite communications have been limited primarily to position location and data services in the transportation and shipping industries. Voice grade land mobile communications services by a U.S. licensee will not be available in the United States for several years at best. Even these services will require relatively bulky ground equipment for reception from and transmission to geostationary satellites.

The IRIDIUM™ system design has resulted in a revival in consideration of LEO satellites for real-time voice and other

^{13/} See U.S. Patent No. 5,095,538 (filed Sept. 29, 1989; issued Mar. 10, 1992). (Attachment D hereto).

^{14/} By separate cover, Motorola is forwarding to the Commission information concerning several of these patent applications. Confidential treatment of this highly sensitive and company proprietary information is respectfully requested pursuant to Section 0.459 of the Rules. See 47 C.F.R. § 0.459 (1991). Attachment E hereto is the cover letter to Motorola's confidential treatment request.

telecommunications. Motorola has taken an old concept -- LEO satellites -- and surrounded that concept with many highly advanced subsystems, and thereby created a new, innovative personal communications system. To convince oneself of the innovative nature of Motorola's contribution, one need only compare the number of trade press and technical journals referencing LEO satellites for real-time voice communications before and after Motorola's public announcement of the IRIDIUM™ system on June 26, 1990.^{15/}

Others have proposed the commercial and noncommercial use of LEO satellites for real-time and store-and-forward data communications in the VHF/UHF bands ("little" LEO's). Motorola's personal communications vision is substantially different from those LEO satellite systems proposed in the VHF/UHF bands. The latter are primarily directed at providing store and forward data communications services over a relatively small bandwidth. The IRIDIUM™ system, on the other hand, will be capable of providing worldwide voice communications on a real time basis to tens of thousands of users simultaneously. Moreover, unlike the proposed "little" LEO systems, the IRIDIUM™ system constellation will ensure universal service to any point on Earth.

Motorola was the first to propose and develop LEO technologies for the provision of ubiquitous real-time digital voice communications services for handheld personal subscriber units. The technological innovations encompassed in the IRIDIUM™

^{15/} Attachment F hereto includes a series of articles in newspapers, periodicals and the trade press which reference the IRIDIUM system.

system will enable, for the first time, persons located anywhere in the world to communicate with one another regardless of the nature and extent of their respective terrestrial telecommunications infrastructures. Communications services to be offered over the IRIDIUM™ system will include digital voice, data, paging and RDSS, as well as provide for interconnection to the public switched telephone network.

Finally, the IRIDIUM™ system is extremely spectrum efficient, with its cellular architecture and multiple spot beams providing over 200 times frequency reuse worldwide, and its bidirectional operations in the RDSS uplink band resulting in an unsurpassed channel capacity per MHz of service band. In fact, Motorola's FDMA/TDMA modulation techniques will allow for as many as 4,400 simultaneous channels over CONUS in just 10.5 MHz of RDSS uplink spectrum. None of the other proposed LEO satellite systems can offer such spectrum efficiency.

V. THE IRIDIUM™ SYSTEM CONCEPT
IS TECHNICALLY FEASIBLE

No other satellite system in this group of RDSS applicants has been as thoroughly tested and designed as the IRIDIUM™ system. Motorola has had the IRIDIUM™ concept under development for over four years -- at least two years prior to the filing of its system application with the Commission. During this time, it has spent over \$50 million on research and development activities.

Motorola also is in the process of conducting extensive propagation experiments and simulations of critical components in the design in order to demonstrate the technical feasibility of the IRIDIUM™ system.^{16/} While these tests are still in progress, Motorola is able to provide the Commission with preliminary results concerning several important experiments.^{17/} Among other things, these preliminary results confirm the IRIDIUM™ system's design characteristics under adverse propagation conditions. Thus, burst communication of voice packets have been shown to permit link closure under time varying fading conditions. This burst interval must be shorter than the expected duration of fades. The use of efficient Vocoder/Error Correction Schemes yields additional, equivalent link margins in excess of the baseline system margin.

Motorola also has confirmed, by a combination of propagation data and computer simulation, that the IRIDIUM™ system will provide reliable communications even in environments of heavy shadowing by trees, multipath caused by reflecting

^{16/} These experiments are being conducted pursuant to Special Temporary Authority. See Request for Pioneer's Preference of Motorola, File No. PP-32, Exhibits (July 30, 1991). Motorola also has pending experimental license applications to conduct more extensive testing of many of the components of the IRIDIUM™ system. These tests will be performed in four phases, culminating in an in-orbit testing of several prototype satellites. While all of these tests will be necessary before Motorola can enter into full production of the IRIDIUM™ satellites, the experiments and simulations conducted to date clearly demonstrate the technical feasibility of the overall system design.

^{17/} All of these results are highly confidential and company proprietary, and accordingly they are being provided to the Commission by separate cover letter in accordance with Section 0.459 of the Rules.

surfaces, and inside vehicles. These results are based significantly upon propagation data collected since 1990 and are ongoing.^{18/}

In addition, Motorola has conducted voice and data simulations of key components of its system design. For example, Motorola performed various demonstrations of speech communications over the IRIDIUM™ system in heavily shadowed propagation conditions. These simulations further support the technical feasibility of the system design.^{19/}

Motorola's comprehensive system application provides additional support as to the technical feasibility of the IRIDIUM™ system and the innovations contained therein. Motorola also commissioned an independent "Red Team" in the Summer of 1990 to review critically the technical feasibility of the IRIDIUM™ system design. This Red Team was led by a senior engineer formerly of Comsat Laboratories and was comprised of technical experts from Comsat Laboratories. These experts concluded that the IRIDIUM™ system is technically feasible. This Red Team continued to offer their critical review through the system concept review in September 1990 and the preliminary design review in January/February 1991. They also have been called upon

^{18/} Id.

^{19/} A videotape of this simulation is being provided to the Commission with a request for confidential treatment pursuant to Section 0.459 of the Rules. A copyrighted computer software program demonstrating the workings of the IRIDIUM system's intersatellite links also is being provided to the Commission under separate cover.

as needed to offer critical comment as the design continues to progress.

Subsequently, potential international investors in the Spring of 1991 commissioned Comsat General (California) to evaluate the feasibility of the IRIDIUM™ space vehicle design. Their conclusions once again validated the feasibility of the technical design.

VI. OTHER CONSIDERATIONS RELATING
TO MOTOROLA'S PREFERENCE REQUEST

Although the Commission has indicated that it generally is not in favor of granting nationwide preferences,^{20/} in this case a nationwide geographic preference is warranted. All of the LEO applicants have requested such a preference. LEO systems inherently are not limited to small geographic areas. Indeed, several LEO applicants, including Motorola, have proposed global systems. In this regard, the Commission has observed, that "[w]here a service area is inherently nationwide, we will consider granting a nationwide preference."^{21/}

Awarding Motorola a pioneer's preference for its proposed LEO system would not be tantamount to authorizing it a nationwide monopoly for MSS and RDSS in the United States. As

^{20/} See Report and Order, 6 FCC Rcd. at 3495.

^{21/} Id. The Commission apparently granted VITA a nationwide preference for its LEO system below 1 GHz. See Tentative Decision, at ¶ 22.

Motorola has previously pointed out to the Commission,^{22/} its use of only 10.5 MHz of service spectrum still would leave over two-thirds of the RDSS bands for other qualified applicants to operate their proposed systems. More spectrum also may be available for such systems as a result of the decisions reached at the recently-completed World Administrative Radio Conference ("WARC-92"). In addition, the United States already has a domestic MSS licensee in the upper L-band authorized to operate in 28 MHz of service spectrum, and the Commission soon should be authorizing LEO systems below 1 GHz to provide radiodetermination and other satellite data services. Thus, Motorola would not be providing either RDSS or MSS on a monopoly basis if the Commission were to grant it a nationwide pioneer's preference for use of only one-third of the RDSS service bands.


^{22/} See Motorola's Reply Comments (Jan. 31, 1992).

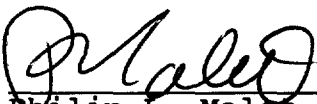
VII. CONCLUSION

For the foregoing reasons as well as those set forth in Motorola's renewed Request for a Pioneer's Preference, the Commission should grant Motorola a nationwide pioneer's preference for its innovative IRIDIUM™ system concept.

Respectfully submitted,

MOTOROLA SATELLITE
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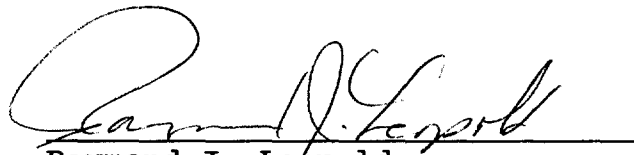
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Its Attorneys

April 10, 1992

DECLARATION

I, Raymond J. Leopold, hereby declare under penalty of perjury that I have either prepared or reviewed the materials and information set forth in the foregoing Supplement to Motorola's Request for a Pioneer's Preference for its IRIDIUM™ system; and, that said information and materials contained therein are true and correct to the best of my knowledge, information and belief.

A handwritten signature in dark ink, appearing to read 'Raymond J. Leopold', is written over a horizontal line.

Raymond J. Leopold
Chief Engineer
Motorola Satellite Communications, Inc.

Date: 4/10/92

CERTIFICATE OF SERVICE

I, Philip L. Malet, hereby certify that the copies of the foregoing Supplement to Request for Pioneer's Preference were served by first-class mail, postage prepaid, this 10th day of April, 1992, on the following persons:

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- * Commissioner James H. Quello
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To: Office of Engineering and Technology

ATTACHMENTS

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